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(72)Inventor : ENOMOTO HIROMICHI

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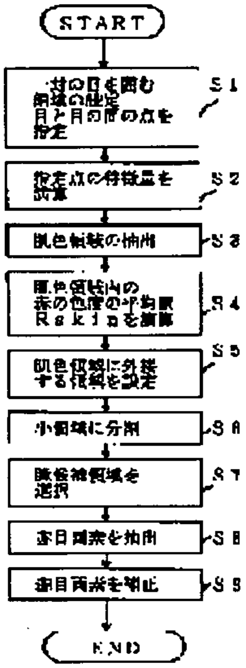
(54) IMAGE PROCESSING METHOD

(57)Abstract:

PROBLEM TO BE SOLVED: To simply execute red-eye correction in a flash image with high accuracy.
SOLUTION: An area surrounding a couple of eyes is set, a point between the eyes is designated (S1), a characteristic amount of a color at the designated point is calculated (S2), a skin color area is extracted from the inside of the setting area (S3), a mean value of the red chromaticity in the skin color area is calculated (S4), an area circumscribing the skin color area is set (S5), the area is divided into small areas (S6), a pupil object area is selected among the small division areas (S7), a red-eye picture element in the pupil object area is extracted (S8) and then the red-eye picture element is corrected (S9).



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CLAIMS

[Claim(s)]

[Claim 1] the poor color tone of the pixel by which the small field where possibility that it is characterized by providing the following is high was chosen as a pupil candidate field, the color tone extracted the poor pixel out of the pupil candidate field by which selection was carried out [aforementioned], and extraction was carried out [aforementioned] -- an amendment -- the image-processing method characterized by things To the photography picture by which the pupil was contained in the photographic subject, the field where the poor color tone of one or more pupils may exist is set up, the inside of the field which carried out [aforementioned] a setup is divided into two or more small fields, and it is the colour information of each aforementioned smallness field. The pupil in which the poor color tone exists based on positional information.

[Claim 2] The image-processing method according to claim 1 characterized by asking for the central point of the field which set up and this set up the range surrounding one pair of pupils as a field where the poor color tone of the aforementioned pupil may exist by calculation, and performing division into a small field, and selection of a pupil candidate field based on the colour information and positional information on the basis of this central point.

[Claim 3] It is the image-processing method according to claim 1 characterized by to perform division into a small field, and selection of a pupil candidate field based on the colour information and the positional information on the basis of the point which performed a setup of the range surrounding the one aforementioned pair of pupils by setting up the field of the area which specified one near the middle of one pair of pupils, and was beforehand set up focusing on the this specified point, and carried out [aforementioned] specification.

[Claim 4] the field where the poor color tone of the aforementioned pupil may exist be the image processing method according to claim 1 characterize by perform division into a small field , and selection of a pupil candidate field based on the colour information and the positional information on the basis of the point of having specify the range in which one or more pupils surround one pair of pupils with a poor color tone , and having specify and this specify the point near the center of one pair of pupils .

[Claim 5] It is the image-processing method of any one publication of the claim 1 characterized by performing division into the aforementioned smallness field by dividing into the field which extracted the edge pixel from the inside of the field by which a setup was carried out [aforementioned] based on colour information, and was surrounded by this edge pixel - the claim 4.

[Claim 6] It is the image-processing method of any one publication of the claim 1 characterized by performing selection of the aforementioned pupil candidate field by searching for the performance index which shows pupil-likeness about each combination which made the two aforementioned smallness fields 1 set based on colour information and positional information, and choosing combination with the highest evaluation - the claim 5.

[Claim 7] It is the image-processing method of any one publication of the claim 1 characterized by performing amendment of the aforementioned color tone poor pixel based on the lightness information on color components other than the red of a color tone poor pixel - the claim 6.

[Claim 8] It is the image-processing method of any one publication of the claim 1 characterized

by an operator performing amendment of the aforementioned color tone poor pixel based on the information on the color chosen from two or more color samples - the claim 7.
[Claim 9] Amendment of the aforementioned color tone poor pixel is the image-processing method of any one publication of the claim 1 characterized by enabling adjustment of the amendment field of a color tone poor pixel - the claim 8 by setting up arbitrarily the threshold about the colour information for an operator extracting a color tone poor pixel.

[Translation done.]

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DETAILED DESCRIPTION

[Detailed Description of the Invention]
[0001]
[The technical field to which invention belongs] this invention relates to the amendment image-processing method in the poor color tone of the pupil within the photographic subject picture by flash plate luminescence at the time of color photography photography.
[0002]
[Description of the Prior Art] conventionally, the color tone of the aforementioned pupil is poor -- some amendment technology is proposed in the so-called bloodshot eyes (references, such as U.S. JP,5130789,B and JP,7-72537,A) . The technology indicated by U.S. JP,5130789,B surrounds the circumference of the target eye with a rectangle mask, specifies several points of the field of bloodshot eyes with a pointer, sets up the field of bloodshot eyes based on colour information, and if an object pixel is in this field, it will judge with bloodshot eyes and it will amend it. Under the present circumstances, the amount of amendments is changed according to the distance from the boundary of a field.
[0003] Moreover, the technology indicated by JP,7-72537,A specifies the field of the target eye, selects a candidate pixel by colour information, also considers the information about each label after labeling, and evaluates whether they are bloodshot eyes. Moreover, it divides into the main part and periphery of bloodshot eyes about the amendment method, and the amount of amendments is changed.
[0004]
[Problem(s) to be Solved by the Invention] It is necessary to specify several [in the field of bloodshot eyes] further, and a burden starts an operator about the technology of U.S. JP,5130789,B besides surrounding the circumference of the target eye with a rectangle mask. although the candidate field is set up by comparing two or more sexual desire news with a threshold about the technology of JP,7-72537,A, since the sexual desire news of the portion surrounding especially bloodshot eyes changes greatly with a photography scene and individual differences, it is set up on the same conditions -- things are difficult and become the cause by which this reduces yield Moreover, since it is necessary to divide a main part and a periphery also about the amendment method, and to change the amount of amendments, it is complicated.
[0005] this invention was made in view of such a conventional trouble, and aims at offering the image-processing method which enabled it to amend bloodshot eyes with a sufficient precision simply.
[0006]
[Means for Solving the Problem] For this reason, as shown in drawing 1 as a functional block diagram, invention concerning a claim 1 To the photography picture by which the pupil was contained in the photographic subject, the field where the poor color tone of one or more pupils may exist is set up, and the inside of the field which carried out [aforementioned] a setup is divided into two or more small fields. The colour information of each aforementioned smallness field, the poor color tone of the pixel by which the small field where possibility that the pupil in which the poor color tone exists based on positional information is included is high was chosen as a pupil candidate field, the color tone extracted the poor pixel out of the pupil candidate field

by which selection was carried out [aforementioned], and extraction was carried out [aforementioned] -- an amendment -- it is characterized by things

[0007] Moreover, it is characterized by for invention concerning a claim 2 asking for the central point of the field which set up and this set up the range surrounding one pair of pupils as a field where the poor color tone of the aforementioned pupil may exist by calculation, and performing division into a small field, and selection of a pupil candidate field based on the colour information and positional information on the basis of this central point.

[0008] Moreover, it is characterized by to perform the division into a small field, and selection of a pupil candidate field based on the colour information and the positional information on the basis of the point which performed a setup of the range in which invention concerning a claim 3 surrounds the one aforementioned pair of pupils by setting up the field of the area which specified one near the middle of one pair of pupils, and was beforehand set up focusing on the this specified point, and carried out [aforementioned] specification.

[0009] moreover , the field where , as for invention concerning a claim 4 , the poor color tone of the aforementioned pupil may exist be characterize by perform division into a small field , and selection of a pupil candidate field based on the colour information and positional information on the basis of the point of having specify the range in which one or more pupils surround one pair of pupils with a poor color tone , and having specify and this specify the point near the center of one pair of pupils .

[0010] Moreover, it is characterized by invention concerning a claim 5 performing division into the aforementioned smallness field by dividing into the field which extracted the edge pixel from the inside of the field by which a setup was carried out [aforementioned] based on colour information, and was surrounded by this edge pixel. Moreover, it is characterized by invention concerning a claim 6 performing selection of the aforementioned pupil candidate field by searching for the performance index which shows pupil-likeness about each combination which made the two aforementioned smallness fields 1 set based on colour information and positional information, and choosing combination with the highest evaluation.

[0011] Moreover, it is characterized by invention concerning a claim 7 performing amendment of the aforementioned color tone poor pixel based on the lightness information on color components other than the red of a color tone poor pixel. Moreover, it is characterized by invention concerning a claim 8 performing amendment of the aforementioned color tone poor pixel based on the information on the color which the operator chose from two or more color samples.

[0012] Moreover, invention concerning a claim 9 is characterized by amendment of the aforementioned color tone poor pixel enabling adjustment of the amendment field of a color tone poor pixel by setting up arbitrarily the threshold about the colour information for an operator extracting a color tone poor pixel.

[0013]

[Effect of the Invention] the colour information out of each smallness field which divided the field where the poor color tone of one or more pupils may exist according to invention concerning a claim 1, and positional information -- being based -- highly precise -- a pupil candidate field -- it can choose -- with, the color tone poor pixel in this pupil candidate field -- an amendment -- things can perform bloodshot-eyes amendment with a sufficient precision

[0014] Moreover, according to invention concerning a claim 2 - a claim 4, a pupil candidate field can be chosen with high precision by an operator's minimum burden. moreover, the thing which is divided into the field surrounded by the edge pixel according to invention concerning a claim 5 -- abbreviation -- it can divide into a small field with the same color tone base, and becomes easy to extract a color tone poor pixel from the inside of a small field

[0015] Moreover, according to invention concerning a claim 6, when bloodshot eyes occur especially on two pupils by evaluating two small fields about combination as 1 set, a pupil candidate field can be chosen in a high precision by the performance index using symmetric property. moreover, according to invention concerning a claim 7, it doubles with the inclination of this lightness based on color components other than red, for example, blue, and green lightness information -- as -- red or red, blue, and green lightness -- an amendment -- things can amend to natural sensibility

[0016] moreover -- according to invention concerning a claim 8 -- an operator -- from a color sample -- choosing -- a favorite color -- an amendment -- things are made Moreover, according to invention concerning a claim 9, the variation in the colour information of the color tone poor field which embraces the grade which an operator senses that a color tone is poor, can expand or contract, and can set up an amendment field by setup of a threshold, and is generated according to a photography scene and individual differences, and its boundary region is absorbable.

[0017]

[Embodiments of the Invention] Below, the operation gestalt of this invention is explained based on drawing. Drawing 2 shows the system configuration of 1 operation gestalt. The digital image data which read with the scanner the color picture which was photoed by the digital image data or the silver salt film camera of the color picture photoed by the still video camera, and was developed by the film are memorized by the storage 1, such as an optical disk.

[0018] The image data memorized by the aforementioned storage 1 is read by the control unit 2, and image display is carried out to a monitor 3. While an operator sees the picture displayed on the aforementioned monitor 3, to the photographic subject picture which has produced bloodshot eyes by flash plate photography, by setting up a picture field as follows, the aforementioned control unit 2 amends by extracting the pixel of bloodshot eyes out of the this set-up field, and displays the amended picture on a monitor 3.

[0019] Below, the routine of the bloodshot-eyes amendment concerning this invention is explained according to the flow chart below drawing 3 . Drawing 3 shows the main routine of bloodshot-eyes amendment. Step (it is described as S drawing.) it is the same as that of the following -- in 1, while setting up the rectangle field surrounding the circumference of one pair of eyes to the photographic subject picture containing the pupil displayed on the monitor 2, it specifies as a reference point of the colour information which mentions one near the middle of the eye of a couple later, and positional information (refer to drawing 6) .

[0020] ** [an operator may specify an object domain and a midpoint as the setting method of the aforementioned object domain and a midpoint, it may specify only an object domain and you may ask for a midpoint by calculation] (for example, making the center of the specified rectangle field into a midpoint calculation) It is good also considering the area which specifies only a midpoint and is beforehand set up considering there as a center as an object domain. As [both] a precision of bloodshot-eyes amendment, in order that the 1st method may perform specification of an object domain, and specification of a midpoint by the manual, it is the highest.

[0021] The feature of this invention is specifying the field which surrounds one pair of pupils even when the number of pupils with a poor color tone is one in one pair of pupils. moreover, the case where one pair of pupils [both] are bloodshot eyes -- 1 time of a block definition -- simultaneous -- two bloodshot eyes -- an amendment -- things are made For example, with the technology indicated by aforementioned U.S. JP,5130789,B, in order to carry out a block definition at a time about one pupil, an operator's degree of intervention becomes large.

[0022] The colour information of the point specified at the aforementioned step 1 in Step 2, for example, R, (red) G (green) B (blue) Total value of each lightness value (R+G+B) It calculates as characteristic quantity. At Step 3, the field of this beige pixel is extracted by making the pixel within the threshold specified by the difference of characteristic quantity with the characteristic quantity of the aforementioned specifying point into a beige pixel. That is, since the point near the middle of one pair of eyes is located in the root portion of a nose by the aforementioned specifying point and it is presumed that the color in the point is beige, the field which is carrying out the color near this point can be presumed to be a beige pixel. In addition, the hue and saturation which are general colour information are not cared about as characteristic quantity. Thus, labeling of the pixel within the aforementioned threshold is carried out, and the labeling field where a specifying point is included is extracted as a beige field.

[0023] At Step 4, the average Rskin of the chromaticity [=R/(R+G+B)] of the red in the aforementioned beige field is calculated. Rectangle field circumscribed to the beige field extracted at the aforementioned step 3 in order to reduce the following amounts of operations, and the amount of data required for this operation at Step 5 (both eyes the portion between eyes included so that it may circumscribe simultaneously one oblong field) It sets up as a new object domain. A setup of this rectangle field is performed by being automatic. Although you may carry out manually, it is automatic, and when the operator has performed a latus block definition in which fields other than a face are included, it can respond by carrying out.

[0024] The aforementioned object domain is divided into a small field at Step 6. The sub routine of this small field division is explained according to the flow chart of drawing 4 . At Step 11, it asks for an edge pixel in the field by which a setup was carried out [aforementioned]. How to ask for this edge pixel is lightness. (R+G+B) It considers as characteristic quantity and asks for the sum of the absolute value of the difference of 4 pixels [of circumferences of an object pixel] lightness, and if it is more than the threshold that this set up, an object pixel will be judged to be an edge pixel. In addition, you may use edge-detection filters, such as a Sobel operator and a Prewitt operator.

[0025] At Step 12, labeling of the edge pixel detected at the aforementioned step 11 is carried out. At Step 13, the pixel which had the methods of three surrounded at least by the edge pixel of the same label is changed into the same label as the aforementioned edge pixel. That is, the field surrounded with the edge serves as the same label. Thus, a setting field is divided into a small field with the same label.

[0026] It returns to the main routine of drawing 3 , and the field where possibility that the pupil in which a poor color tone exists is contained is high is chosen as a pupil candidate field at Step 7 from the small fields by which division was carried out [aforementioned]. The sub routine of pupil candidate field selection of the aforementioned step 7 is explained according to the flow chart of drawing 5 .

[0027] With this operation gestalt, it asks for pupil-likeness by calculating the following characteristic quantity about all combination, using as 1 set two of two or more small fields by which division was carried out [aforementioned]. Step 21 -- the chromaticity [=R/(R+G+B)] of the red of each smallness field -- asking -- the inside of a field -- the highest value of a red chromaticity (Ri) and the time of making into a zero the point near [which was specified at the aforementioned step 1] the middle of an eye and an eye -- the aforementioned highest value (Ri) Position on the X-axis of a pixel, and a Y-axis (Xi, Yi) It considers as characteristic quantity Here, i expresses the value which discriminates a small field.

[0028] For example, when combining the small field 1 and the small field 2, a pupil candidate field is chosen as follows. At Step 22, the characteristic quantity C12 of colour information and the characteristic quantity P12 of positional information are calculated by the following formula. characteristic quantity P12=X1+X2+Y1+Y2 of characteristic quantity C12=R1+R2 positional information of colour information -- here Since pupil-likeness is so high that the characteristic quantity of positional information is so small that the characteristic quantity of colour information is large, at Step 23 The characteristic quantity E12 which shows pupil-likeness is set up with E12=C12-P12, and the color tone of at least one side is poor in the combination of the small field where this value is the highest. (bloodshot eyes) It extracts as a pupil candidate field where possibility that the pupil which has become is included is high.

[0029] Here, to the point between eyes, when bloodshot eyes are in both pupils, the thing with high pupil-likeness will depend right-and-left one X1 on a bird clapper small, if X2 of + and another side is totaled as -, so that the characteristic quantity of positional information becomes small. Moreover, when the combination of both pupils is chosen, the thing as which the case where only one pupils are bloodshot eyes is sufficient will be because it becomes large [the characteristic quantity of the color upper part], if that the value of positional information P12 becomes small even if there are no bloodshot eyes in one pupil, and there are a bloodshot eyes also compares it with the combination in which bloodshot eyes do not have one.

[0030] The color tone out of the pupil candidate field which returned to the main routine of drawing 3 and was extracted at Step 7 in Step 8 is poor. (bloodshot eyes) A pixel is extracted. This extraction method is as follows. the average Rskin of the beige field for which the chromaticity [=R/(R+G+B)] of the red of an object pixel asked at Step 2 -- large -- in addition -

- and characteristic quantity of the colour information of an object domain (Ri) from -- when larger than the value which lengthened the set-up threshold TH, it considers as a bloodshot-eyes pixel That is, let the pixel which fills the following formula be a bloodshot-eyes pixel.

[0031] At the R/(R+G+B) >Rskin**R/(R+G+B) >Ri-TH step 9, the bloodshot-eyes pixel extracted at Step 8 is amended to a proper color tone. In this case, since all pixels are looked very unnaturally to the same pixel value with an amendment, lightness information other than red is harnessed. for example, digital value -- R, G, and B -- the amendment of the gray color which digital value doubled with the low value most when it was R= 200, G= 50, and B= 30, respectively In this case, since the lightness of R=G=B=30 can be amended in the pupil picture reflected to some extent, it is visible to natural sensibility.

[0032] since [or] it corresponds when the color of a pupil is not a gray from the first -- for example, the above -- the same -- digital value -- R, G, and B -- when it is R= 200, G= 50, and B= 30, respectively, G and B maintain a value as it is, and double R with 50 of G by the value of the larger one of G and B, and this case In addition, you may make it double the value of R with 40 by the average of G and B, and this case.

[0033] furthermore, the case where the color of an operator's favorite pupil is not suited -- pallet of the color of a pupil (sample) from -- a favorite color -- choosing -- I have you -- a basis [news / sexual desire / the] -- amendment As the method of amendment, the following procedures perform, for example. It asks for the colour information of the selected color, for example, YIQ, by the following formula.

[0034]

[Equation 1]

$$\begin{bmatrix} Y \\ I \\ Q \end{bmatrix} = \begin{bmatrix} 0.3 & 0.59 & 0.11 \\ 0.6 & -0.28 & -0.32 \\ 0.21 & -0.52 & 0.31 \end{bmatrix} \begin{bmatrix} R \\ G \\ B \end{bmatrix}$$

[0035] In a bloodshot-eyes pixel, the maximum of the value of B+G is calculated and this is set to Lmax. To the lightness Y of a pallet, it is L (=B+G) of an object pixel. The value broken by Lmax is multiplied. (refer to the following formula) .

Maintaining, the value of Y'=YxL/LmaxI and Q is transformed inversely to R, G, and B, and makes this digital value correction value. By doing in this way, it is more visible to nature.

[0036] That is, about lightness, although a pallet performs selection of a color, since amendment is performed taking advantage of the lightness information on components other than the red of a bloodshot-eyes pixel, natural sensibility can also be acquired. In a series of processings, although it asked for the red chromaticity, you may use combination, such as other general colour information, for example, lightness, a hue, and saturation. According to this operation gestalt, the following effects are acquired.

[0037] ** There are few degrees of intervention of an operator and they end.

** the influence according to a photography scene and individual differences as compared with the method of dividing only using colour information, since field division is carried out using edge information -- receiving -- hard -- high yield -- an amendment -- things are made

** When the color of the above and a pupil is not a gray, also in other than a Japanese, it can respond by performing the aforementioned amendment.

[0038] Next, the 2nd operation gestalt is explained. With the operation gestalt of the above 1st, a part of bloodshot-eyes portion to correct according to the individual differences of a bloodshot-eyes portion may be amended, or it may be amended to the portion which is not bloodshot eyes. In order to prevent this, while an operator looks at a picture, the threshold for distinguishing the existence of amendment is adjusted and it enables it to adjust an amendment field with this operation gestalt.

[0039] An operator specifically looks at a picture, when an operator judges repeatedly that it is amended to the portion which is not bloodshot eyes conversely until it lowers the value of the threshold TH set to the aforementioned bloodshot-eyes pixel extraction and the amendment field was expanded appropriately, when it was judged that a part of portion of bloodshot eyes is amended, the value of the aforementioned threshold TH is raised, and it repeats until an amendment field is reduced appropriately.

[0040] There is also a portion undertaken to subjectivity about a field setup of bloodshot eyes, and amendment to which an operator's subjectivity is satisfied to do in this way can be performed. Moreover, the variation in the colour information of the bloodshot-eyes [which are generated according to a scene and individual differences] and bloodshot-eyes circumference is absorbable.

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DESCRIPTION OF DRAWINGS

[Brief Description of the Drawings]
[Drawing 1] The block diagram showing the composition and the function of this invention.
[Drawing 2] Drawing showing the system configuration of 1 operation gestalt.
[Drawing 3] The flow chart which shows the main routine of the bloodshot-eyes amendment in an operation gestalt same as the above.
[Drawing 4] The flow chart which shows the sub routine of small field division of a routine same as the above.
[Drawing 5] The flow chart which shows the sub routine of pupil candidate field selection of a routine same as the above.
[Drawing 6] Drawing showing the specification method of the object domain in an operation gestalt same as the above.
[Description of Notations]
1 Storage
2 Control Unit
3 Monitor

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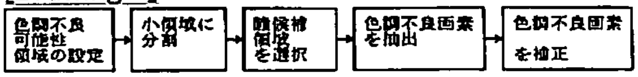
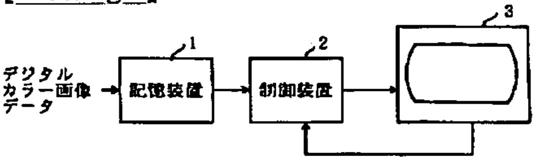
DRAWINGS

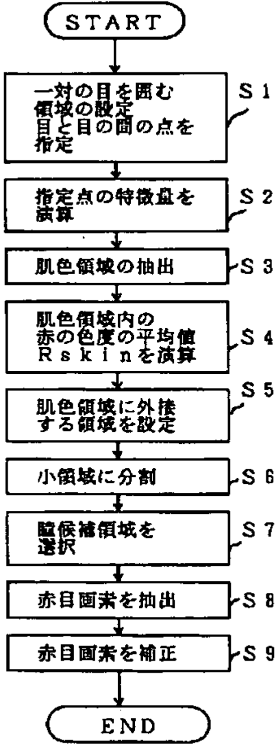
[Drawing 1]


色調不良可能性領域の設定
小領域に分割
瞳候補領域を選択
色調不良画素を抽出
色調不良画素を補正

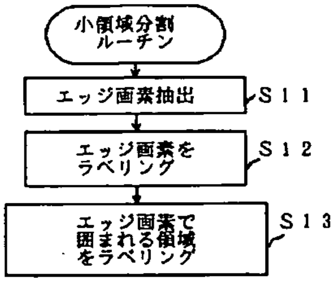
[Drawing 2]


デジタルカラー画像データ
1
記憶装置
2
制御装置
3

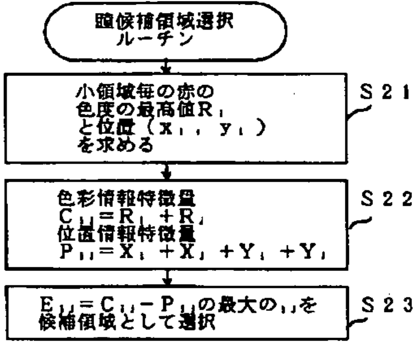
[Drawing 3]


START
一対の目を囲む領域の設定 目と目の間の点を指定
S 1
指定点の特徴量を演算
S 2
肌色領域の抽出
S 3
肌色領域内の赤の色度の平均値Rskinを演算
S 4
肌色領域に外接する領域を設定
S 5
小領域に分割
S 6
瞳候補領域を選択
S 7
赤目画素を抽出
S 8
赤目画素を補正
S 9
END

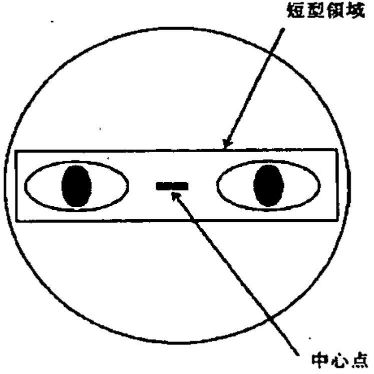
[Drawing 4]


小領域分割
ルーチン
エッジ画素抽出
S11
エッジ画素を
ラベリング
S12
エッジ画素で
囲まれる領域
をラベリング
S13

[Drawing 5]


瞳候補領域選択
ルーチン
小領域毎の赤の
色度の最高値R_i
と位置（x_i， y_i）
を求める
S21
色彩情報特徴量
$C_{ij}=R_i+R_j$
位置情報特徴量
$P_{ij}=X_i+X_j+Y_i+Y_j$
S22
$E_{ij}=C_{ij}-P_{ij}$の最大のijを
候補領域として選択
S23

[Drawing 6]



[Translation done.]